Learning Trajectories and Professional Development: Student Teacher in Electrical Engineering

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Abstract

The article is set within the framework of teacher professional development. The research presented in this paper aims investigating the learning trajectory of a student teacher during practical experience. To understand the process of learning trajectories of the student teacher, we observed and analysed three video sessions: the first records the student teacher in a real classroom at a vocational high school in Electronics, Energy and Communicating (ELEEC). The lesson was attended by 12 male students, with an average age of 17, enrolled in the last year of vocational high school; the second video records a meeting between the student teacher with the university trainer; and the third video shows a meeting with the senior teacher. The videos and field notes were collected and qualitatively analysed by two researchers. The aim of this analysis was to single out the dimensions able to give an account of the learning trajectory of the student teacher toward their professional development as a teacher. Eight indicators were found and they were grouped into three dimensions able to describe the process of gradually gaining expertise.

Keywords

Professional development, learning trajectories, student teachers, learning trajectories, expertise

Résumé

Cet article dans le cadre du développement professionnel des futurs enseignants. Son propos vise à analyser le processus d'apprentissage d'un élève-enseignant lors d'une expérience pratique d'enseignement. Pour comprendre ce processus, nous avons procédé à l'analyse de trois séances vidéoscopées. La première enregistre l'élève enseignant lors d'une séance d'enseignement en Baccalauréat professionnel Électrotechnique, énergie, équipements communicants. La séance concerne douze étudiants de sexe masculin, avec un âge moyen de dix-sept ans ; la deuxième et la troisième montrent les séances de régulation mises en place successivement entre l'élève enseignant et le formateur enseignant de l'université d'une part. Et d'autre part entre l'élève enseignant et le tuteur référent de l'établissement. Les vidéos et les supports d'enseignement ont été analysés qualitativement afin de dégager les dimensions et les indicateurs qui permettent de rendre compte du développement professionnel de l'élève enseignant. Huit indicateurs et trois dimensions permettent de rendre compte de ce processus de construction de l'expertise.

Mots-Clés

Développement professionnel, processus d'apprentissage, élèves-enseignants, expertise

Introduction

The educational system for teacher training is undergoing deep transformation in many countries (De Kock, Sleegers & Voeten, 2004). This complex process should lead to a rethink about what are the optimal training programmes and curricula for better promoting the professionalization of teaching (Cochran-Smith & Lytle, 1999).

In general, it is assumed that the teacher should be actively involved in their work driven by passion for teaching, enthusiasm, satisfaction and self-motivation, considering knowledge as a resource to be mobilized (Perrenoud, 2002). Controlling and managing the class, identifying the purpose of the lesson, adapt the work to the various skills of the children, ask questions, use tools to improve student school performance are recognized expertise of a teacher (Bennett, 1993). This educational dimension should be accompanied by ethical and moral characteristics (Fenstermacher, 1992; Oser, 1992; Beijaard, Verloop & Vermunt, 2000).

The student teacher is confronted, therefore, with a complex role during teacher training. The educational system of teacher training faces a challenge, especially in order to understand and promote the passage from theory to teacher practice (Goodson & Cole, 1994; Bullough & Gitlin, 2001).

The purpose of this paper is to explore the role of the practical experiences during

teacher training at university level in order to promote the professional development of student teachers, in the line of an integrated curriculum for teacher education (Smagorinsky, Cook & Johnson, 2003).

In order to pursue this aim, we first discuss teacher professional development and the transitional role from education to a professional setting during teacher training. Then, we present the analysis of the data collected for this study. This analysis can provide suggestions for the improvement of teacher training at university level.

Teacher professional development

Within the school system, the teaching profession refers to the quality and the role of the teacher, related to their experience and skills (Clement, 1995; Hargreaves & Goodson, 1996). A sense of efficacy of the teacher, professional development, ability and willingness to address educational changes and realize innovations in teaching practice are considered features of the teaching profession (Kompf, Bond, Dworet & Boak, 1996).

Profession and professionalism are abstract concepts, expressed in actions, experiences and knowledge. For these reasons, they can be investigated only indirectly, finding traces in the form of their manifestations. This can also give information on the teachers' habitus (Bourdieu, 1972), closely connected with the tacit dimension of experience.

Related to the teacher's professional development, central is the role played by the teacher professional identity (TPI) (see for a review, Beijaard, Meijer & Verloop, 2004). Teacher professional identity is a complex and multi core concept (Cooper & Olson, 1996), consisting of several factors intertwined, such as the conceptions and expectations of others, social image, practical experience and personal background (Walkington, 2005). The identity is formed, therefore, by engaging with others and is shaped by the context in which it is taught, experience in the field and the biographical profile of the teacher (Beijaard et al., 2000). Beijaard et al. (2000) describe the identity of teachers as being composed of three sub-identities: pedagogical expertise, subject matter expertise and educational expertise. Recently TPI has been conceptualized as a continuous and dynamic process of sense making and reinterpretation of values and experiences, at the same time unitary and multiple, continuous and discontinuous, individual and social (Akkerman & Meijer, 2011).

The process of self-reflection is very useful to increase the skills and promote the professional development needed to face the changing professional contexts (Alsup, 2005). According to Korthagen and Vasalos (2005) reflection should be conducted with the support of an experienced educator, connected to a specific activity and aimed at looking back to the actions, facilitating the creation of alternative scenarios. The self-analysis and evaluation of the knowledge of the discipline of teaching must be complex and articulated (Bennett & Carrè, 1993), allowing the teacher to shape and

reshape the self-image (Cooper & Olson, 1996). Orland-Barak and Hayuta (2007) discuss the impact student teachers' reflections have on their own classroom discourse in their understanding of the connections between theory and practice, with the aim of understanding how practice fits theory; connecting theory and practice to generate grounded theories of practice; and developing practical theories.

The training of the teaching profession is a process 'in progress' that involves the interpretation and reinterpretation of experiences (Kerby, 1991) through a process of reflection that activates the cognitive and emotional resources. Indeed, reflection should therefore be constant within the teacher training programme, as a personal assessment and as a step to continuing education. In this way, education becomes a tool for the construction of professionalism (Perrenoud, 1994).

Student Teachers In A Professional Context

Teacher training plays a fundamental role in forming the base for professional development (Flores & Day, 2006). The participation in a learning community leads to the acquisition of new rules, roles, practices and processes, which in turn leads to becoming a professional, and also affects identity (Bruner, 1996; Brown & Campione, 1999). In a community of practice (CoP) (Lave & Wenger, 1991; Wenger, 1998), the concept of learning is as a process related to participation in contextualized practices, influencing and interacting dynamically with the processes of identity construction. Indeed, the learning process allows the construction of new meaning and decision making for teacher identity (Korthagen, 2004; van Huizen, van Oers & Wubbels, 2005).

The entry of the student to a teacher training programme can be conceptualized as a gradual process of integration into the teacher community, which we can consider as a legitimate peripheral participation (Lave & Wenger, 1991). In this perspective, the newcomer (student teachers in our case) moves from a position as a general student to full participation as a teacher. This conquest of centrality in the community of reference allows the subject to become an expert in the specific practice and thus become an effective member of the community. This progress is intended as a gradual trajectory, conditioned by the specific nature of the situation. The novice in this process has the chance to experience access to local resources, developing relational and procedural skills (Brown & Duguid, 1991, 2001). According to Lave and Wenger, learning through participating in a CoP is particularly effective when the participants have full access to different parts of the practices; there is sufficient horizontal interaction among participants and when the resources, technologies and structures are transparent and available. Hutchins (1995) speaks of the 'horizon of observation' to emphasize the prospect available to the novice to participate in the activities through different channels (instruction, imitation, interpretative models etc.).

Interaction with experts helps the newcomer to 'see' the social mediated reality, encouraging the understanding and the coordination of tasks. It is activated as a process of scaffolding (Wood, Bruner & Ross, 1976) between the demands of the task and the level of expertise required. This process is particularly effective when the expert is recognized as such by the novice, becoming a reference point. The importance of interaction between expert and newcomer is central in different communities, as shown by Goodwin (1994) in the research on an archaeologist community. The expertise arises from the involving of participants in a social and situated activity, thanks to the use of coding schemes: external stimuli organized into categories and events relevant to the professional work; highlighting (making visible to others what is considered relevant to the specific activity); and articulation of graphical representations (collection of a wide range of aspects in a single representation, such as graphics, photographs and inscriptions). Indeed, the learning of the newcomer in the practices of the community is mediated by social negotiation in significant and complex interaction with peers and with other professionals (Dillenbourg, 1999).

Between professionalism and training must be established a bond of reciprocity, that can be represented by the practical experience (called stage in French). The stage can become for the student teachers a connector between education and the professional setting (Lambert, 2003), as we explore more fully in the next section.

Stage as Crossing Boundaries

Of particular use in teacher training is the experience of stage, as the moment of crossing the boundary between the educational and professional system: 'the transition from a community of practice to another can lead to a real transformation' (Zittoun, 2008, p. 121). Transition is a process that requires human transformations and changes in the relationship with the environment, entails identity alterations, learning process, definition of new skills and the construction of new meaning (Zittoun, 2008, 2014).

The ability to look at two different systems (university as preparation and school as future professional setting) that interact through a joint action on the same object (teacher professional development) implies a reconstruction of objects, processes and functions. Between the two systems, the stage is a 'boundary zone', a physical and symbolic border area, in which there is interaction (Tuomi-Grohn, Engeström & Young, 2003). Indeed, the internship creates a pattern that connects (Bateson, 1972): the educational and professional contexts are intermingled and are mutually beneficial, allowing the student teacher to experiment competences in a context that creates meaning.

The stage requires specific skills and is therefore dependent on the resources and constraints of the contexts of use. However, the skills acquired directly in specific contexts show poor generalization ability (Carraher, 1986; Schliemann & Acioly, 1989), and

will meet unexpected changes or difficulties if no theoretical support is offered or made available. For this, it is important that the practical experience is done in continuity with the educational training, helping the student teachers to adapt to the unpredictability and changes of the transition process. It is important, therefore, that the advantage of experience, through simulated environments and social interactions specially created, smooths this transition (Resnick, Säliö, Pontecorvo & Burge, 1997).

In this process, the interaction of the novice with the expert becomes central. The research on expertise (Scribner, 1984) shows that the cognitive characteristics of an expert are linked to the definition of the problems, flexible solutions, integration of the context in the problem solution system, optimization of effort as a strategy and dependence on specific knowledge. Also, reflective practice is a further conceptual tool to define the thought of the expert (Schon, 1983). This becomes part of a 'know-how' that the expert develops, especially in situations of uncertainty, of transformation, putting together reflection and action. Thus, there emerges a multidimensional and hybrid view of expertise (Tuomi-Grohn et al., 2003).

Below we present the research. We will focus on the teacher student prospective to reveals decisive steps of a novice teacher's professional development, during training.

Objects of the research

The research aims to examine the learning trajectory of a student teacher in teaching practice. The research question that guided this work is as follows: How are the learning trajectories of a student teacher characterized in practical experience?

To answer this question we observed a teacher student performing a lesson in a real class during his training programme. Then, the teacher student was observed during post-teaching discussion with the senior experts: the university trainer and the senior teacher. So, the focus of our analysis will be the teacher students. This analysis can give information on the characteristics of the stage as a 'place' of authentic learning and show the elements involved in the process of the learning trajectory.

Methodology

Context and participants

This research is part of a larger project aimed at improving and assessing the initial teacher training. The observed teaching session is conducted by a teacher student in a class of first-year students on the Bachelor Professional Electronics, Energy and Communication course (called in French 'Bac Pro ELEEC'). The discipline is 'Industrial Science and Technology' in technological and scientific training. In the first year, this subject is taught for 10 hours a week. It is the heart of training for future electricians. The observed lesson was organized under the direction of a tutor from the ESPE and

a placement tutor at the school, and is a part of the TD of the second semester of the MEEF (see the section "A French experience in teacher training" to more information on this). The observed session is titled 'Pipeline section and protection of installations'. It aims to bring future electricians to determine the section of a power line and the calibre of the protection of the pipeline. It is built from a reference work situation to contextualize knowledge and procedure of choice.

Specifically, the participants in the research are:

- *The student teacher*: female, 23 years old. She is in the second year of the MEEF and training to become a teacher in electrical engineering. She holds a bachelor degree in Industry, Technology and Electrical Engineering (2010), a Higher National Diploma in electrical engineering (2012) and a professional licence as 'Technical Coordinator for Electrical Installations' (2013). In 2014, she began the MEEF master. The professional experience of the candidate is four weeks' training conducted as part of the training curriculum in the first semester of the course.
- *The university trainer*: male, with 15 years of teaching in LP (called in French 'Bac PRO ENERGETIQUE') with a specialization in energy engineering business. He has worked as a teacher educator in the ESPE for 11 years, training LP teachers in industrial specialization (electronics and energy).
- *The senior teacher*: male, specialized in electronic engineering and with practical experience in the electronic industry, a teacher in LP for 13 years and specifically with 8 years in 'Bac Pro ELEEC'.

Below we present deeply teacher training and vocational training in a/the French context to a more exhaustive analysis of our research context.

A French experience in teacher training

At the end of the middle school (called *College*), the student can choose between Vocational High Schools (LP), for a professional and technical learning, or humanistic and technological high school.[1] It takes two years to prepare for The Professional Skills Certificates, called CAP, and three years for the Bachelor Professionals, called Bac Pro (Cheneval-Armand & Ginestié, 2008). These qualifications attest to the acquisition of knowledge and skills in an industrial or tertiary professional field. In 2013–2014, vocational courses accounted for over 40% of young people in senior high school (MENESR-DEPP, 2014).

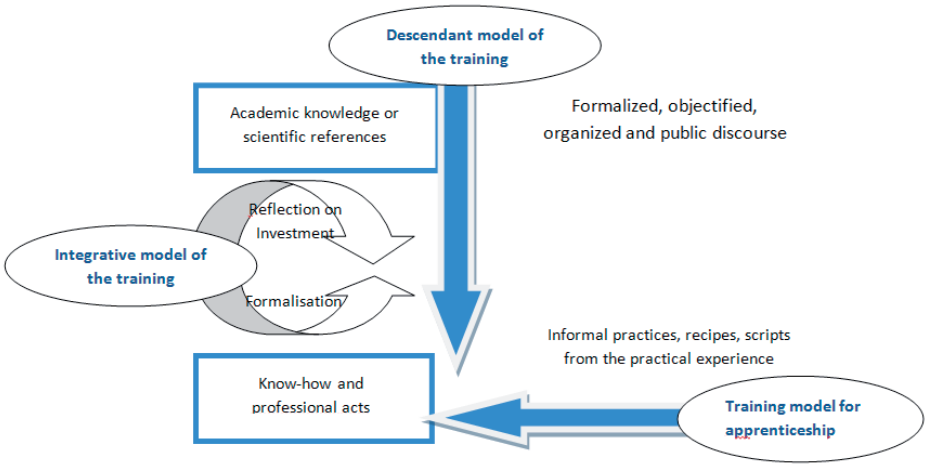
To teach in LP, the teachers must hold a master degree called '*Métiers de l'enseignement, de l'éducation et de la formation*' (MEEF) provided by the university, and to pass a national examination. In this way, the teacher gains the so-called '*Le certificat d'aptitude au professorat de lycée professionnel'* (CAPLP) to be able to teach.

1 For details on the French educational system, see official websites: http://www.france.fr/en/studying-france/french-education-system-nursery-school-high-school.html.

Since the academic year 2013, the Higher Schools of Teaching and Education (called 'ESPE') provide initial teacher training. The new structure of training aims to achieve a double objective: complete the process of 'universitarization' of initial teacher training (undertaken by the reform of 2009); and 'professionalize' the teacher role by establishing, during the master programmes, an integrative approach between theory and practice. In this way, the student teachers can gradually enter into the profession. In the first year, the internships are designed as a professional simulation. In the second year, the teacher students, admitted to the national competitions, have the status of 'official trainees' and can undertake a practical experience in a school, corresponding to the equivalent of a part-time teaching service. This is to enable all students who seek access to careers in teaching, education and training to acquire the knowledge and build the skills necessary to become a professional teacher. At the same time, they acquire the ability to do their job not by applying only traditional methods and approaches but by designing appropriate training schemes for each student, taking into consideration any difficulties related to students' social status. The aim is to reach a common foundation of knowledge and skills for all student teachers making them capable of acquiring a professional qualification.

In our opinion, the challenge is to suggest an innovative approach to teacher training, for a more integrated approach between theories and practices. In this way, it will be easier to move from a descendant approach (where the acquisition of knowledge comes before the professional learning) to an integrative model of education, where knowledge and professional skills combine closely with the contexts of practice and scientific/didactic approaches. This proposal is detailed in Figure 1:

Figure 1



Integrative model of initial teacher training

Here we describe a practical proposal based on the integrative model of initial teacher training: Tutorials (in French called: *Travaux Dirigés* –TD).

A system based on integrative alternative: Delocalized Tutorials (Travaux Dirigés –TD)

The initial training proposed by the MEEF is based on practical experiences. This stage enables student teachers to build competencies related to the knowledge taught in the different teaching units (TU), throughout the curriculum. In the first year of the master's course (MI), the practical experience is based on activities of observation, aimed at the construction of the first skills in the teaching. The teacher students have to:

- Actively participate in the organization of teaching sequences, considering the respective subject area and grade level;
- To assess the effectiveness of choices.

These goals are achieved with the strict collaboration between the teaching staff of the ESPE and the guided supervision of a tutor in the school.

In the second year of the master's course (M2), the practical experience allows each teacher student to work in the teaching profession under an appropriate monitoring and scaffolding supervision. During this experience, the student teacher carries out all the components of the role of a teacher, participating in all activities concerning the life of a school, in terms of teaching (preparing lessons, teaching lessons, assessment, etc); academic support (participation in the educational life) and institutional involvement (participation in the school project, relationship with stakeholders, etc.).

Throughout the practical experiences, in a strict integrative approach, the Aix Marseille ESPE has implemented a specific collective training experience in the practice, called tutorials (*Travaux Dirigés – TD*). These tutorials take place at the university and the school, allowing a 'round trip' between practical experience (the first being the observation internships, and the second stage involving more responsibilities) and the curriculum programme of the teacher training. This system allows a real exchange between students, tutors and trainers on 'professional issues referred to the common experience of teaching or educational sequences. Two steps guide the organization of the TD:

- The first step is the practical experience of the student in the class. This is done in the presence of the ESPE referent and the tutor to implement a teaching session in the corresponding subject area and grade level;
- The second step takes place in the presence of the ESPE tutor and school tutor and should empower the student to assess and interpret the first professional practice elements and make the connection between knowledge and experienced professional practices.

It is from this perspective that we carried out the research described.

Data collection and corpus data

The data was collected through participant observation. The three sessions were recorded for a total of 90minutes. The three sessions were organized as follows:

1. The first session. During the first video-taped session, the class was working during the lesson. The session took place in the regular classroom. The teacher and the trainer attended the lesson conducted by the student. They were sitting at the back of the class together with the researcher. Twelve students were present, all male, aged about 18 years old. The teacher student presented her lecture with the aid of a PC linked to a projector. The same format was given to the students in paper version. The computer screen of the teacher was projected on the wall in front of the students to enable them to follow. The teacher also used a blackboard. The activity had a total duration of about one hour.
2. The second session. The second session was held in the same class after the lesson. It consisted of a meeting between the university trainer and the student teacher. The teacher used a sheet of notes to take into consideration the various points to be highlighted. The session lasted about 20 minutes in total.
3. The third session was a meeting between the student teacher and the senior teacher. The meeting lasted about 10 minutes. A review of the same class was made with the senior teacher, as had been done previously with the trainer. Again in this case, the teacher used a sheet of notes taken during the lesson.

After obtaining the necessary informed consent of the students, a researcher attended the activity using a semi-mobile video camera. The same researcher also collected field notes. The three video sessions are useful in order to understand the trajectory of learning of the student teacher. The focus of our observation is the student teacher and her mode of interaction with the class, the trainer and the teacher.

Data was collected using the direct and semi-direct participation methods. The researchers have tried to preserve a natural situation. The same researcher was present in all three sessions. So, the corpus of the data obtained consists of: 1) the three video recordings relating to three sessions; 2) one A4 sheet for each session of field notes collected. The camera was semi-mobile, thus allowing field notes to be taken. The main source of the analysis was the three videos, and field notes were used as data support for the interpretation.

Data analysis

The data analysis was qualitative in nature and had as its objective to understand the process of the learning trajectory of the student teacher in practice. Using the constructivist perspective, grounded theory (GT) was applied to analyse the data (Glaser, 1998; Charmaz, 2006; Bryant & Charmaz, 2007) and to interpret and make simplifications, and through this process we have identified dimensions and indicators from data, in accordance with our research question.

We performed the following steps: a) All the video data was viewed more than once, in order to identify episodes that can provide useful elements to answer our research question; b) Significant episodes were identified. These have the features of being homogeneous and relevant to our objectives, with recognizable moments of a beginning and end, in which it was possible to recognize indicators of the learning trajectory; c) Once selected episodes had been chosen, we proceeded to the transcript of verbal interventions using the Jefferson code (2004). All sections were made by all the researchers involved who discussed and agreed all stages of the analysis, reaching total agreement.

Results

The following results, taking in consideration the three sessions, consist of eight indicators grouped in three dimensions (Table).

Table 1

Dimensions and indicators of the process of learning trajectory for the student teacher

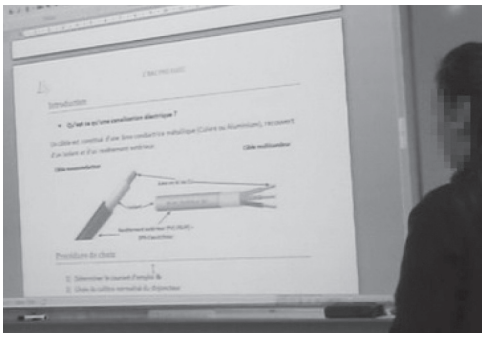
Dimensions	Indicators
Pedagogical expertise	Object-oriented activity Questions Individualized support
Educational expertise	Rules Responsibility for student's learning Meaning of learning
Subject matter expertise	Situated learning Correct content

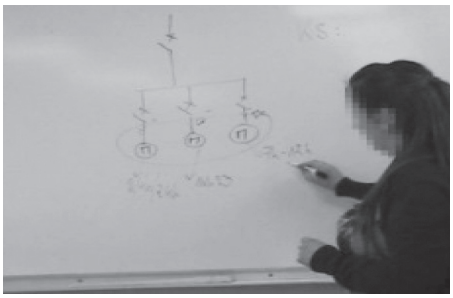
The dimensions were drawn from both the literature (Bullough & Gitlin, 2001; Beijaard, Meijer & Verloop, 2004) and from the process of analys is. Below we will discuss in detail each dimension, reporting the salient features relative to the identified indicators.

Pedagogical expertise

The first dimension useful for describing the process of the learning trajectory of the student teacher is the pedagogical expertise. In the first part of her lecture, the teacher starts the lesson showing the format and explaining the learning task. During this first phase (about the first 10 minutes of the lesson), the student teacher is constantly facing the whiteboard and projection on the wall; she does not address any questions to the students or attempt to interact with them, as is captured in the two images below (Figure 2 & 3).

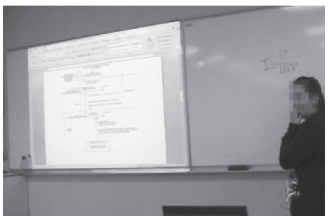
Figure 2 & 3





Artefacts used by the teacher student (4.49 minutes and 9.95 minutes)

Figure 4



Use of questions by the student teacher (12.44 minute)

Figure 5

Direct and mediated interaction (58.28 minutes)

The student teacher's attention is directed to the technological (blackboard, projection, pc) and semiotic artefacts (mathematical formulas, scheme etc.) that become the main interaction with the students.

Excerpt 1 below shows how the student teacher (below indicated as S-teacher) uses the artefacts to manage and activate the epistemic dimension (content and knowledge) to start her lesson:

Excerpt 1[2]: The student teacher introduces the learning task

1. S-teacher: So, we have to see when we will have here and here (*she circles the numbers*). Do you all know the formula? (*while she talks, she is writing the formula on the blackboard*). So we have a three-phase system....
2. Student: (*inaudible*)
3. S-teacher: Look (*she approaches the pc*) ... on the scheme you have one, two, three, so it's a three-phase system. Here we can see (*moves to the power point and indicates the point on the diagram*)....
4. Students: (*buzz of conversation*)
5. S-teacher: I can hear you (*she still has her back to the class*). Here we have (*marks the point on power point and moves to the blackboard to write the formula*).... And this is also indicated on your paper document.

Extract 1 shows that the teacher gets support from artefacts (diagram, PC, blackboard, and paper document) and epistemic artefacts (formula, underscores, points to observe).

In the second part of the lesson (from about 10 to 40 minutes), the relationship with the class evolves and the student teacher uses the questions as her main pedagogical strategy. Figure 4 captures a moment when the teacher asks the students a question.

The student teacher begins to pose more questions of a different type (rhetoric, to probe understanding or draw attention) to students and speaks more to them.

Excerpt 2: Checking understanding

1. S-teacher: Do you all understand the formulas or not?
2. S-teacher: (....). Is it ok until now? What will we choose in this table?
3. S-teacher: So, what does the delivery tell us? We have to remember all the features of the cables… This is marked on the diagram… Is it clear here?
4. Student: (*buzz of conversation*)
5. S-teacher: Well, because we found two other characteristics ... .What did we choose in this table? We took the value 'U'….Why?
6. S-teacher: On this document here, what is the information? What do you think 3 and 4 mean? So we...

2 The sentences are translated from French to English. They were compared between the two researchers to ensure a close translation.

From this second extract we can see that the teacher improves the relationship with the students with the use of different kinds of questions. At the same time, she continues to use the main artefacts for her interaction with the students.

In the last part of the lesson (from 40 to 60 minutes), the student teacher introduces a final pedagogical strategy: she goes directly in the bench to probe and stimulate the student learning, as is captured in Figure 5.

The teacher shows more flexible interaction, as demonstrated by extract 3:

Excerpt 3: Direct and mediated interaction

I. Student teacher: Come on, tell me! (*She is turning around students' benches*).

At the end of the lesson, the student teacher is more open to the relationship and interaction with the students, using a more direct approach with them. The pedagogical dimension is thus enriched with a form of scaffolding, distributed between artefact and interaction.

Educational expertise

Below, we analyse the second dimension identified. The educational dimension emerges in the 'the review of the lesson between the student teacher with the university trainer (indicated below as U-trainer). The first dimension that emerges concerns the common rules, in which the teacher should monitor compliance.

Excerpt 4: Compliance with rules

I. U-trainer: About the taking into account of the class, a student came late…

2. Student teacher: Ah! ... I realized afterwards that I....I have say to myself ….
3. U-trainer: You gave no reaction, no reaction!
4. Student teacher: Yes…
5. U-trainer: ….and the mobile phone that is played….
6. Student teacher: He told me he keeps it in his backpack ... .so I said to myself it is not worth doing anything about it if he says he'll turn it off ... however, if he had put it on the table....
7. U-trainer: You have to manage this kind of thing, it is normal ... however, the delay ... Put some limits…Indeed, the senior teacher intervened....

In this excerpt we see the student teacher's own opposition to the educational dimension, showing a slight resistance to the observations of the university trainer.

A second issue that falls within the educational dimension is the responsibility for the students' learning.

Excerpt 5: Responsibility for students' learning

1. U-trainer: You asked a lot of questions ...well ...But, for example, you asked, what is the tube composed of? And then you said ... it is made up of this and this....
2. Student teacher: Ehhh (*smile)*

3. U-trainer: Well, then suddenly you have not asked a question, you have not related it (...) Always think about starting the discussion, to make them the actors...
4. U-trainer: And you turn to the students, pointing to them generally....
5. Student teacher: Yes, I do not know their names yet…so...
6. U-trainer: Ok ... but ... The two guys who were at the back were a little behind and they were not able to do the exercise alone.
7. Student teacher: But I went to them….
7. U-trainer: Yes, you went but you didn't see why they had failed. They failed to do it themselves because they had not followed the first procedure well.
8. Student teacher: Ah well…but there was a lot of noise ... .So, I said, I said 'be quite twice and so...
9. U-trainer: Ok, ok
10. Student teacher: And then, there wasn't much noise…
11. U-trainer: Yes, but they weren't following and listening….

From this extract it emerges that the university trainer is leading the student teacher to an awareness of the importance of the rules (silence and attention) to take advantage of the learning. The student teacher shows some resistance, trying to defend her position (like e.g. 'yes, but I…').

Finally, the last pedagogical dimension that emerges is the importance of giving an objective to the students about the learning that is taking place during the lesson, showing the importance of the meaning of learning (not always clear and immediately perceived by the students during the theoretical lessons), as shown in excerpt 6:

Excerpt 6. Meaning of learning

1. U-trainer: The previous knowledge of the students ... .You suddenly started....
2. Student teacher: Ah yes….
3 U-trainer: You started with the description of the cables; you didn't raise many questions, because what is the point, if they have already seen some similar cables...
   Student teacher: Yes, that's true…
9. U-trainer: If you have encountered this kind of work ... .You…you left and you skipped this part a bit… you have to think…
11. Student teacher: No, in fact I was under pressure to do everything in 4 pages, so it was tight, tight, tight, and this resulted in the situation 'where I had to direct them because E. (the teacher) told me to do so...
11 U-trainer: It would have been enough to say ... we will work on the size of the cables and then ... a direct link with your activity and the topic...
12. U-trainer: (….) Well, listen ... .Then the end ... the projection; suddenly you finished, without telling them how they could apply what they had learnt.

13. Student teacher: Hmmm… for me, the problem is that I know that in real life this is not useful because it is done by the automatic software with all the formulas ... and then ...
14. U-trainer: So you could have said... usually it's annoying to do this on paper so today we have the software ... This could provide continuity with what you may do in the next lesson, showing the software for example…
15. Student teacher: I thought ... .It is not very interesting if I talk about the software ... but also, I learned this on paper....
16. U-trainer: Yes, but you have to make a projection; you cannot finish in this way...
17. Student teacher: Ah (*she laughs*)
18 U-trainer: What skills are involved here? You put it on to the document and then do not discuss it with the students….
19. Student teacher: Oh, that ... I made that for you (*laughs*).
20. U-trainer: No! Do not do anything for us, not anything, even for your career ... you have to do it for the good of the class …You prepare your lesson properly and then you see your good work unfold in the class...

In this excerpt we can find various contradictions in the vision of the novice student teacher. She expresses her awareness of having to introduce the topic in a different way (pedagogical dimension) but at the same time she expresses her need for doing the entire lesson as she had planned (*in 4 pages, so it was tight, tight, tight*). At the same time, she does not assume direct responsibility for the projects but places that with the senior teacher (*it was he who told me to do so*).

The second contradiction emerges when she expresses the "inutility" of her lecture: on the one hand, she knows that the student will never use this procedure in real work (because it is done automatically with software) and the other hand, she does not want to tell them this so as to avoid the students losing interest in the planned activity. From this, we can see the rigidity of the position of the student teacher as a novice in learning solutions.

The third contradiction that emerges is to do with the training. Indeed, she had explained the theoretical learning skills on the working sheet for the tutors and the teacher but not related to the students' task. The university trainer helps her to find easy and alternative solutions to these contradictions, showing how to change and shape the situation in the most optimal way for learning purposes.

Subject matter expertise

This last dimension emerges during the discussion with the teacher, which focuses on the aspect of content, without neglecting the relationship and pedagogical dimensions, as shown in excerpt 7:

Excerpt 7: Situated learning and correct content

1. Senior teacher: (…) to see the level of understanding of the class and then get so…you see…because you talk about current ... you have to put them in the situation a bit ....
2 Student teacher: Yes, I have to accompany them...
3. Senior teacher: To check if they are there ... and are always paying attention…
4. Student teacher: True!
5. Senior teacher: When you ask students to respond ... .they must respond ... and then let everyone participate in the discussion...
6. Student teacher: I didn't know their names and I didn't want to ask them ….you, you, you…This was something that I didn't like at school and it made me feel uncomfortable....
7. Senior teacher: Then some more explanations ... .the explanation on the symmetry of the cables were not correct!
8. Student teacher: Ah, poor them….I was convinced ...Maybe I hadn't learnt it properly....
9. Senior teacher: In the explanations, find more applications and examples, taken from current examples, find some situations that they know....
   Student teacher: This is something that I am still not capable of doing....
11. Senior teacher: And a student tried to get your attention ... and it is not only about the question, but to open the discussion, ask if everyone agrees....
12. Student teacher: But whom? Those who were at the back?
13. Senior teacher: Yes, yes...
14. Student teacher: I didn't hear….
15. Senior teacher: You didn't react to them ...You have to ask if there is agreement, if there are other possibilities, there isn't only one road....
16. Senior teacher: In the end, you didn't give them the value of the cable there (showing on the sheet)...

As shown by the intervention of the senior teacher, the dimension of the content is central (he emphasizes some incorrect technical explanations), but at the same time he emphasizes the importance of the pedagogical and educational dimensions. The position of the student teacher is still uncertain but oriented to changing, recognizing areas for improvement ("*It is true, I have to improve this etc.*").

Discussion and Conclusion

The research presented here concentrates on the comparison of three sessions, in which the focus is on the teacher student, first in the classroom and then in discussion

with the trainer and the teacher. From these sessions, we have tried to extrapolate some dimensions that could give an account of the process of the learning trajectory with which the student teacher, from the position of novice, is faced on the path to professional development. From the qualitative data collected in the three sessions we have identified eight indicators grouped in three dimensions: a) Pedagogical expertise; b) Educational expertise; c) Subject matter expertise. The analysis of the three dimensions reflects those identified by Beijaard, Meijer and Verloop (2004).

In the first session there emerges a vision of a teacher who plays a very central role in the conducting of activities, trying to keep control through the use of artefacts and a highly structured task. During the lesson, the student teacher tried pedagogical and teaching strategies, such as scaffolding. The repertoire of strategies is enriched in the course of the session, but the use remains highly circumscribed and with contradictions.

The comparison between the expertise and the novice takes place during the two sessions. With the university trainer emerges the educational dimension, while the teacher focus on the content, with the need to deeply anchor it in the context. Both the experts in their discussions focus directly on trainee's omissions or on trainee's non appropriate choices. From the entire comparison recording, we can identify an attitude of acceptance and encouragement by the senior teacher (probably for the conformable relationship established in the practical work) and a more rigid communication of the university tutor, creating a form of distance (due probably at his evaluative and more "academic" role). However, the styles of counselling are not the focus in our analysis.

From the teacher student answers during these confrontations, we can trace forms of resistance to change but also a progressive awareness. Indeed, the ability to find flexible and contextualized solutions and knowledge, optimizing effort as a strategy, and dependence on specific knowledge can be considered an aspect of the process of expertise (Scribner, 1984). For this reason, we believe that a real practice for student teachers during teacher training is a key moment to gradually entering the teacher community. In particular, it can be useful if supported by reflection shared with an experienced educator aimed at finding new meaning and alternative scenarios (Korthagen & Vasalos, 2005). This support should provide also positive and constructive feedback, taking in consideration also the emotional slide of the role of counselling. Indeed, expertise is a complex quality to achieve, but the right support with a positive attitude by external consolers and shared personal self-reflections affect the development of teacher professional identity (Akkerman & Meijer, 2011) and professional development. Observing how this actually happens provides useful guidance for structuring targeted interventions aimed at improving the development of student teachers. The question of the articulation of teaching for the acquisition of knowledge, the implementation for the building of competence and the balance between the different knowledge (Cheneval-Armand & Ginestié, 2009, 2011) are key issues in the development of professionalism process.

Finally, this research was conducted along the lines of a pluralistic methodology for analysing teaching practices in class (Canelas, Moro, Schneuwly & Thevenaz-Christen, 1999). Surely a more longitudinal analysis of the student teacher during practical teacher training can provide more information, especially when centred on the self-perception and reflective process. As future research, we consider the potential of the use of video as a tool to support the reflection of the student teacher, with strategies such as video annotation (to enter text comments on specific moments of the recording) and the possibility of sharing such video resources within the community of student teachers involved in teacher training in order to enhance their learning.

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